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EARLY WARNING SYSTEMS

Pilot studies on early warning systems

Note by the secretariat

1. By its decision 18/COP.6, the Conference of the Parties (COP) invited the Parties, according to their financial and technical capacities, to carry out pilot studies on early warning systems utilizing the recommendations of the ad hoc panel, and to report on progress to the Committee on Science and Technology (CST) during its seventh session. The COP also encouraged Parties and international organizations to provide technical and financial support to developing country Parties wishing to carry out such pilot studies on early warning systems.

2. The secretariat received two submissions from Parties on this topic; they are contained in this document for consideration by the Committee. The reports are reproduced as received by the secretariat, without formal editing.

3. The reports emphasize that early warning systems, along with benchmarks and indicators, and desertification monitoring and assessment, have been identified as integral components of the holistic approach to understanding the casual factors and spatio-temporal characteristics of drought and desertification processes. Each of the submissions indicates the scope of traditional practices with regard to early warning systems, focused on monitoring and warning of hazards, including broader technical and social issues of risk assessment and management. Drought early warning systems which incorporate integrated desertification monitoring systems into their activities are now expected to become operational for both the short term and the long term.

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4. Early warning systems have been widely recognized as a key component of disaster reduction strategies and action plans at all levels.

5. The Committee may wish to take note of these submissions and to provide further guidance with respect to the appropriate decision to be taken by the COP.

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Annexes

Annex I

[ENGLISH ONLY]

JAPAN

Integration of benchmarks and indicators, monitoring and assessment, and early warning systems and their application to pilot studies for desertification early warning systems in North-East Asia

Introduction

The development of benchmarks and indicators (B&I) in order to monitor and assess desertification and the establishment of operational and cost-effective early warning systems (EWSs) for drought and desertification are among the principal items on the agenda drawn up by the CST under the United Nations Convention to Combat Desertification (UNCCD).

The previous UNCCD ad hoc panel on EWSs, which consisted of 10 members and experts of relevant institutions, presented two reports (ICCD/COP(4)/CST/4 and ICCD/COP(5)/CST/4). Subsequently, the Group of Experts (GoE), consisting of 25 experts from five regions, was established within the CST in 2001. At the same time, a succession of thematic programme networks (TPNs) has been set up in Asia. Japan has taken an active part in supporting TPN 1 (Desertification monitoring and assessment), hosted by China, and TPN 5 (Strengthening capacity for drought impact mitigation and desertification control), hosted by Mongolia, and is expected to continue its scientific and technological assistance for TPN activities.

This proposal of the University of Tokyo (Japan) for a pilot study in North-East Asia for an EWS establishment will implement recommendations of the ad hoc panel on EWSs, which have been adopted by the CST. The Government of Japan has also previously supported activities and recommendations of the ad hoc panel on EWSs. The integrated model envisaged in the study plan will provide a common foundation for the integration of what have hitherto been treated as separate issues: desertification benchmarks and indicators, both large-scale and regional in scope, desertification monitoring and assessment, and desertification EWSs.

The ultimate goal of the pilot study proposed is to develop desertification assessment and to establish an EWS in North-East Asia by employing an integrated model. In concrete terms, the aim is to promote interdisciplinary and international research by pursuing the following three organically interconnected sub-themes:

(1) to employ an integrated model to establish a desertification EWS;
(2) to standardize observation methods for long-term monitoring of desertification indicators;
(3) to assess land vulnerability through field surveys.

The integrated model created by this research project will make it possible to use land vulnerability as a criterion to assess local-scale desertification, so that land managers and decision-makers can identify the most appropriate land use and establish ecosystem management plans. The integrated model will also enable local assessment results to be extrapolated across a wide area, and the data thus derived to be included in the respective national action programmes (NAPs), which have hitherto often lacked scientific and technological information.

Significance of the pilot study

The ad hoc panel report on international trends in drought/desertification EWSs (ICCD/COP(5)/CST/4) reveals that at present, there is no operational desertification EWS in the world which provides coverage over more than a few years, although some EWSs for seasonal droughts have in fact been utilized on a regional-scale basis. In the light of this present situation, the report recommends that more emphasis be placed on the neglected issue of land vulnerability, and that for the sake of risk management, urgent priority should be given to the initiation of a pilot study to establish a desertification EWS.

Taking these circumstances into consideration, the pilot study for EWS in North-East Asia will take account of the relationship to TPN 1 and TPN 5, and of the CST recommendations. The result of such a study will constitute a major contribution not only to desertification prevention measures in North-East Asia, but also, through generalization of the methods applied, to further discussions at the CST. Therefore, both the urgency and the significance of the project are extremely high. The outcome will be reported to the GoE, and also to COP 7, as an activity carried out by the Government of Japan. It can be expected to have a widespread influence and effect.

Methodologies

A quantitative integrated model should be developed as a method for conducting desertification impact assessment and for implementing countermeasures. In the field of desertification assessment and countermeasures, solutions cannot be produced by focusing on one isolated problem from a single angle, and creating the most effective formula only for this particular problem. Desertification countermeasures consisting exclusively of revegetation provide a good example. This method often causes degradation of local residents' living and water environment.

Desertification assessment should identify the most suitable compromise choice (that is, one which provides for the sustainable use of natural resources) through which a balance can be maintained among the various constituent elements, and whereby the overall system can be preserved, while the land is used to support life, vegetation coverage is maintained to prevent land degradation, and the ecosystem is conserved on a long-term basis, in order to make the most efficient use of limited local natural resources.

Development of a quantitative integrated model is a prerequisite for tackling such a problem, which requires both a comprehensive perspective and adherence to strict scientific objectivity. Essential for such an integrated desertification model is not only a comprehensive understanding of desertification mechanisms, but also an examination of the desertification process within a policy-making and managerial framework, so that the most effective management method can be presented in quantitative terms.

Based on the pressure, state, response (PSR) framework, proposed by the Organization for Economic Co-operation and Development (OECD) as a basic framework for environmental assessment, the pilot study will aim to grasp the relevant phenomena, to construct a model and to apply this model, while paying constant attention throughout to the connection between indicators for land degradation and those for its causes and effects. Desertification occurs through a complex combination of elements on a local scale.

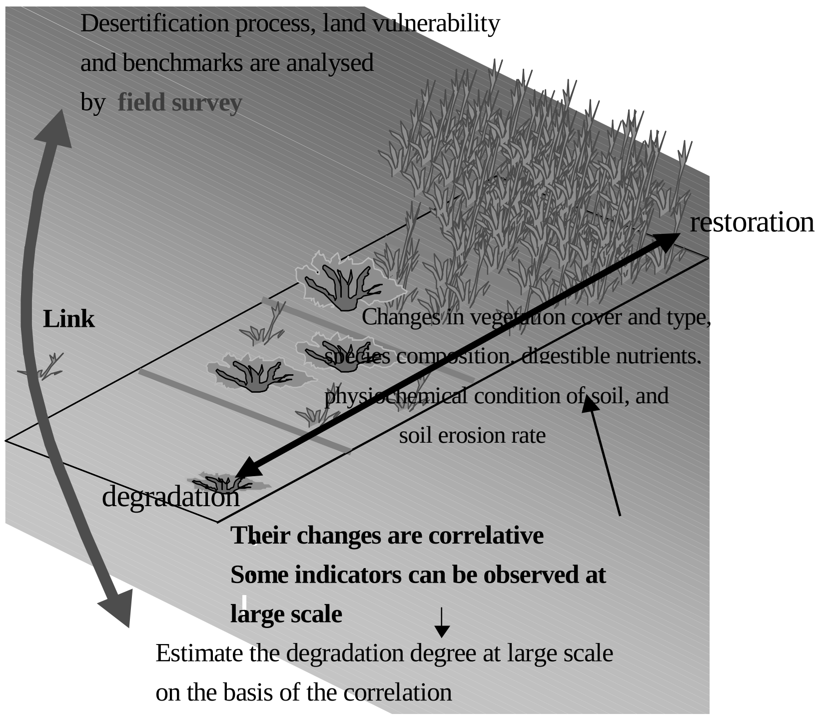
But at the same time, the phenomenon manifests itself on a larger scale. Assessment on this larger scale provides the indispensable basis for policy formation and decision-making; however, the difficulty of combining breadth of scope and depth of complexity in a single examination has meant that conventional desertification research has been compartmentalized according to the different spatial scales involved in each respective project.

Desertification assessment requires arguments built upon diverse indicators, which are obtained by field surveys. For example, the vegetation coverage rate itself cannot reveal ecological stability. Unfortunately, the application of diverse indicators for large-scale observations and estimates capable of supporting an assessment of the desertification process at present remains, and will also remain for the near future, impossible in practice.

Therefore, we need to focus upon the specific processes involved in land degradation in each particular place. And through field surveys on a local scale, we will identify the stages involved in the degradation/restoration process. Subsequently, the stability of the ecosystem during each of these degradation/restoration stages will be assessed, and models will be constructed in correlation to indicators capable of employment for large-scale observation/estimation (figure 1).

In this way, at each spot, it will become possible to assess sustainability through a small number of indicators, which can also potentially be obtained on a large-scale basis. Moreover, because similar environments will most likely follow similar degradation/restoration processes, it will be possible to organize the environment spatial groupings, which will enable large-scale assessments to be conducted by using the landscape ecology method and multiple-point field surveys. By following such an approach, emphasis will be given to observation/estimation through indicators on a large-scale basis, and to understanding the details of the desertification process and benchmarks on a regional scale; the advantages of both spatial scales will be harmoniously integrated.

Figure 1. Conceptual framework of the strategy to integrate large-scale and local-scale studies on desertification

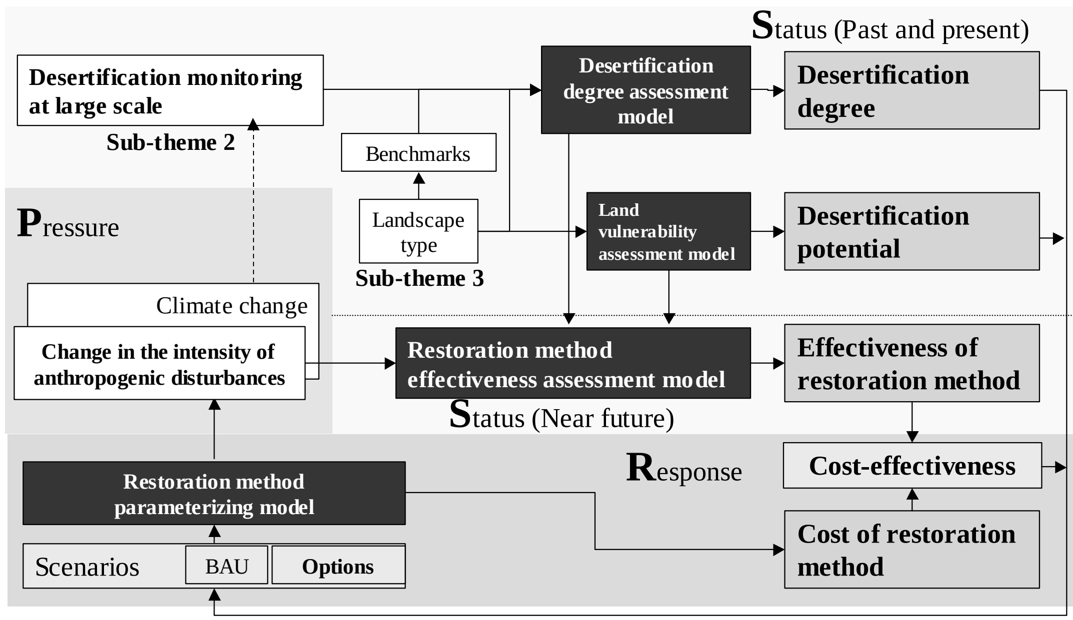


Within this overall framework, the pilot study will be composed of three sub-themes. Sub-theme 1 will involve the coordination of results from sub-themes 2 and 3, and also the development of an integrated model and assessment methods. Sub-theme 2 will involve conducting observation/estimation through large-scale desertification indicators. Sub-theme 3 will involve the adoption of the PSR framework to analyse desertification phenomena on the basis of field surveys and experiments, to establish benchmarks, and to explore restoration measures.

(1) Constructing an integrated model for desertification EWS

Sub-theme 1 will involve the development of an integrated model (figure 2) and assessment methods which will use this model, as well as the coordination of the work being undertaken under the other two sub-themes. First of all, for developing the model, the data obtained under sub-theme 3, relating to degradation /restoration processes of desertification, the critical amount of grazing at each stage, stability and resilience against climate change and human interference, and decisive points for stability and resilience (that is, benchmark stages), will be included in a model in such a way as to permit calculations according to the large-scale indicators treated under sub-theme 2.

Figure 2. Structure of desertification EWS developed by this pilot study



Because the degradation/restoration process involves complex qualitative changes to the ecosystem, here our efforts should be focused on the maintenance of a semi-quantitative empirical model. A parallel element of the modelling exercise should involve versatile process-models (such as models for turnover of organic matter in the soil, soil erosion and grazing), which are capable of large-scale application.

To explore the universal applicability of models over spatial variability, and to cope with those spatial variabilities which could not be explained fully by the groups of indicators under sub-theme 2, empirical parameters, or models, will be constructed individually for each landscape type. Adjustment of the parameters will allow the results calculated for a separate type to be combined in an appropriate way, and account to be taken of any variability in the background environmental elements.

At the same time, macro-socioeconomic information should be collected, both statistical and non-statistical, and an appropriate interpolation method should be found whereby this information could be included in spatial mapping. This information will be managed according to the Geographical Information System (GIS), as will the biophysical indicators for desertification obtained under Sub-theme 2.

Finally, by integrating the models created and the information collected, a large-scale mapping system will be developed to include past environmental changes and grazing pressure changes, and also the degradation/restoration stages which have followed desertification prevention countermeasures, grazing capacity and benchmarks.

Once the system is established, an assessment will follow. First, a simulation covering the last few decades will be carried out to understand long-term desertification trends. At the same time, the politics, economy and environmental policies in the target areas will be taken into account so that their negative impacts on vegetation can be assessed, and the assessment results will be fed back into the integrated model as impacts caused by macro socio-economic factors.

Various environmental policies (scenarios) will be examined in connection with the current desertification conditions, and the benefit accruing from such will be evaluated. Each scenario will be checked for its feasibility in terms of the social, economic and cultural background. In evaluating the effects of a given policy, consideration will also be given to land use regulations, cost-effectiveness (including the human and economic costs of introducing eco-technological measures), and the most appropriate spatial distribution pattern of the numbers of cattle for grazing in order to avoid land degradation and maintain a healthy grazing capacity.

(2) Desertification indicators for long-term monitoring: Standardization of observation methods

Climate indicators (mainly rainfall quantities) and vegetation indicators (mainly the Normalized Difference Vegetation Index (NDVI)) have hitherto dominated the field of large-scale monitoring for desertification assessment. Assessments based on combination of these two sets of indicators have been found effective for short-term EWS such as for drought, but they are not sufficient to provide an accurate assessment for the whole desertification process, which does not become apparent except on a timescale of the order of several years or more, and which is the result of complex interactions between diverse elements. The ad hoc panel on EWS has pointed out the importance of establishing soil as an indicator, because there are direct correlatives for changes over time and the order of desertification, and soil also has a strong influence on land productivity resilience.

With the help of remote sensing, model simulation and GIS, sub-theme 2 will involve the standardization of methods for large-scale and long-term surveys using the biophysical indicators such as vegetation and soil. The vegetation indicators will take into account vegetation type, vegetation cover, biomass and Net Primary Productivity (NPP), and the soil indicators will reflect soil moisture amounts, snowfall, organic carbon amounts in the surface soil, and the degree of wind/water erosion (table 1). In conjunction with sub-theme 3, there will be an examination of the accuracy of each indicator for assessing sustainability, and there will be discussion on any other indicators which might be measured.

Table 1. The indicators which can be estimated at the large scale, and the estimation methods and utilized sensors

Category	Indicator	Method	Sensor
Vegetation	Fractional cover	SMA	AVHRR/MODIS
	Type	BSI	AVHRR/MODIS
	Community height	BSI	AVHRR/MODIS
	Productivity	CASA	AVHRR/MODIS
Soil	Moisture	RTF	SMMR/SMMI/AMSR -E
	Organic content	SMA	AVHRR/MODIS
	Wind erosion rate	WEAM	AVHRR/MODIS
	Water erosion rate	RUSLE	AVHRR/MODIS

The widespread use of remote sensing has made possible an accurate grasp of vegetation indicators; as for vegetation cover and biomass, the NDVI has been found capable of producing accurate results. In this pilot study, by estimating the community height as well as using such two-dimensional information, we shall aim at an accurate estimation of biomass, determination of vegetation types, and improvement in parameterizing models for soil erosion estimates.

For this purpose, we shall develop a technique for the large-scale quantification of the bi-directional reflectance factor effects from three-dimensional structure contained in the satellite observation data. In order to estimate NPP, CASA (The Carnegie-Ames-Stanford Approach) model will be improved to make application possible to arid regions. As for monitoring soil moisture, because the target areas include cold latitudes, some with permafrost, long-term data will be obtained by algorithm based on the microwave radiation data from satellites such as SMMR and SSMI. Organic carbon amounts will be monitored in large areas by extracting soil-derived spectra by linear spectral un-mixing, and producing a regression model to combine spectrum measurements with field survey results.

Wind and water erosion will be estimated by model simulations. Another aspect to be considered is the impact of snowfall in the target areas; there has been no previous attempt systematically to assess soil freezing and related erosion. Through field surveys, we shall develop a method to assess the impact on erosion of snowfall and frozen soil.

(3) Land vulnerability assessment by soil/vegetation/hydrological analysis

If desertification indicators are to be used for land vulnerability assessment, clear benchmarks are necessary. But the lack of clear definition on desertification is causing confusion in discussions of desertification benchmarks. In order to overcome the current problem, the pilot study should take the position that whether or not desertification is occurring depends on whether or not conditions are sustainable, and therefore we need to develop instruments which will enable sustainability to be assessed scientifically. Desertification research on sustainability-related benchmarks is almost non-existent, especially in large-scale projects.

In the target areas, the relationship between natural resources and sustainability returns to the digestible nutrients in plants. The amount of digestible nutrients which can be consumed (grazing capacity) depends upon vegetation types, species composition, the current amount of nutrients and productivity. These factors vary largely according to natural conditions such as climate, topology, geology and soil type. The changes caused by human interference are also clearly apparent.

More concretely, apart from such direct consequences of human interference as cattle grazing, reduced productivity and the diminished luxuriance of species composition/vegetation types, indirect influences are being strongly felt, in terms of physio-chemical changes in soil (soil nutrient degradation, salinization), physical changes (aggregate formation restriction, crust, compaction) and soil erosion. Resilience especially has a strong connection with soil degradation, which not only restricts the recovery of land productivity, but also leads to accelerated and irreversible land degradation. In a desertification assessment, the different stages of the desertification process should be assessed comprehensively.

Sub-theme 3 consists of two sub-themes: (a) Land vulnerability assessment by field survey and (b) Physiological and ecological assessment of soil degradation.

(a) Land vulnerability assessment by field survey

On the basis of a thematic map of climate, topology, geology and soil, we shall first divide the target areas into several landscape types in accordance with their respective landscape ecology, and shall then establish an observation station in each of these districts in conjunction with researchers from the counterpart-countries. Here, monitoring of weather, soil erosion, etc., will be conducted, and the degree of erosion will be estimated based on the activities of radionuclides in the soil. Fences will be established for experiments with different landscapes and different grazing densities, in which there will be a thorough examination of desertification-related indicators, and an investigation of the relation of the degradation/restoration process to the land-use burden, the dynamic equilibrium state, and the rate of change from one level to another (figures 3 and 4).

Parallel to these studies, an extensive survey of the surrounding area will be conducted, in order to gain more knowledge of the longer-term processes of degradation/restoration, to identify similarities in the spatial variabilities involved in these processes, and finally to categorize the environment into groups based on similarity in their background environmental factors. This combination of experimentation and monitoring will reveal the critical point of grazing capacity, and its stability/resilience against climate change and human interference for each environmentally categorized group.

In addition, through identification of the decisive points at which stability and resilience undergo significant changes, the combination of indicators necessary to serve as a baseline will be determined. From the degradation levels established as a baseline, various elements capable of observation by local residents (e.g. plant species composition, vegetation coverage) will be chosen, and benchmarks for diagnosing local land conditions will be suggested. We shall focus especially on indicators for the plant species and, through growth experiments, shall analyse the impact of soil elements on the physiological and ecological character of plant species.

Furthermore, we shall explore the appropriate restoration/management (ecosystem management) methods for each degradation stage. For example, taking land productivity and biodiversity into consideration, a judgement, based on the degree of land degradation, will be made as to whether to restrict grazing density in order to promote vegetation rehabilitation, or to introduce technological methods for soil stabilization and plant cultivation. The results obtained under this sub-theme, once they are combined with the results of sub-theme 2, will become the foundation for mapping degradation stages, stability/resilience and appropriate recovery measures, using the integrated model from sub-theme 1 as a platform.

(b) Physiological and ecological assessment of soil degradation

This sub-theme focuses on the effect of physiochemical characteristics of soil to vegetation, species composition and net-primary productivity in particular. We shall carry out growth experiments in the laboratory where environments are controlled, by using the samples collected in the target area. Under the environments, where weather condition (radiation intensity, air temperature and humidity) and soil condition (particle size distribution, moisture and nutrient) will be controlled so that the environment in the target area is simulated in the laboratory, the activity of the plant physiology, such as transpiration rate and photosynthesis rate, of the major indicator plant species (e.g. *Artemisia intramongolica*, *A. ordosica, Caragana spp*.) will be analysed in relation to soil characteristics.

We shall provide a model explaining the relationship between the soil factors to the plant physiological and ecological characteristics, as well as the inter-species effects. The validity will be discussed by comparing the model results with the data of vegetation and soil in the target area. Moreover, we shall estimate the change in the species composition and the productivity in the cases where the soil is more degraded and the restoration measures take place. The diagnosis measure for soil degradation by surveying vegetation indicators will also be provided.

For both sub-themes, observation points will be established in four areas - for a case study of sandy land in Naiman county of the Inner Mongolia Autonomous Region, China, where desertification assessment has made good progress through the 'Synthetic studies on evaluation and monitoring of desertification' (2001-2003) funded by the Environment Ministry of Japan; for a case study of the Gobi steppe, in the Southern Gobi Province, Mongolia, where research undertaken by the Mongolian State University of Agriculture has already yielded considerable results; for a case study of the marginal area of steppe and Gobi steppe, Dund Gobi province; and for a case study of steppe in Hentiy Province, Mongolia, which is also an observation target of 'Rangelands Atmosphere-Hydrosphere-Biosphere Interactive Study Experiment in North-East Asia' funded by the Japan Science and Technology Agency / Core Research for Evolutional Science and Technology (CREST).

<u>Specific examples of expected results</u>

(1) When the desertification EWS has been established, it will be used to conduct a simulation of the last few decades, and it will be possible to assess long-term desertification trends, on both a large-scale and a regional-scale basis including the socio-economic background. The results will mark an unprecedented achievement for desertification research in North-East Asia.

(2) The desertification EWS will make it possible to assess various policy options objectively, which will enable the formulation of proposals for the most appropriate and feasible land-use methods, and for an ecosystem management plan, with quantitative information concerning cost-effectiveness provided for each option. Such a system will be the first example in the world of a desertification EWS capable also of policy option assessment.

(3) Through the desertification EWS, there can be a large-scale assessment of desertification progress in arid regions of North-East Asia and of land vulnerability distribution, and preparation for developing a desertification map which includes such factors as soil erosion and grazing capacity. An objective desertification map has been an important priority for the Asian region, and its completion can be expected to have widespread and ramified consequences.

(4) Benchmarks and indicators for local land vulnerability assessment can be proposed for application in fieldwork, which could contribute to the establishment of a technique to diagnose

the level of land degradation. Such benchmarks and indicators, usable for on-site diagnosis, are an international desideratum, and can be expected to be both highly useful and highly functional.

Contribution of the research programme to global environmental protection policies, and its socio-economic significance

The CST 6 made two recommendations to the COP: (1) Parties to the Convention will conduct pilot studies and report their progress prior to COP 7 (scheduled for 2005), and (2) Parties to the Convention and the international agencies will support developing countries in implementing pilot studies (ICCD/COP(6)/L.8). The results of this pilot study will be reported to the CST 7 as evidence of Japan's commitment to desertification EWSs in North-East Asia. This study will also make an important contribution to furthering discussion concerning 'Land Degradation, Vulnerability and Rehabilitation: An Integrated Approach', as a major item on the agenda for both the CST and the GoE (the group of specialists established by the CST).

Implementation of this pilot study will have an especially important connection with Japan's support for TPN 1 and TPN 5 in the Asian region. Benchmarks and indicators, monitoring and assessment, and EWSs, are all closely interconnected, and therefore provision of a platform to integrate them will enhance the progress and integration of discussions within TPNs.

Scientific and technological significance of the pilot studies

The closest existing system to a desertification EWS is DeMonII (Hill et al., 1998) which the University of Trier, Germany, has been developing in the Mediterranean. But this still remains at the level of assessment conducted through desertification indicators (de Jong et al., 1999; Hill and Schutt, 2000). If our research agenda is recognized as one of the pilot studies based on the CST recommendation, it is likely to yield results unparallelled anywhere in the world.

By using the integrated model, the research will suggest a system by which different options for countermeasures against desertification and their cost-effectiveness can be assessed. Since the drought EWSs which currently exist have not yet introduced such a system, this can be expected to be a highly original contribution to the desertification research field.

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Annex II

[ENGLISH ONLY]

TURKEY

In order to reduce the possible harmful effects of natural diseases and recover the situation after disasters, the Crisis Management Unit was first established in 1976. Taking into consideration the recent disasters and their costly effects and human losses, the Emergency Management General Directorate was established under the Prime Ministry in 2000 in Turkey. The General Directorate is responsible for the coordination of all disaster management issues and early warning measures at all levels.

Drought has been a recurrent phenomenon in Turkey for the last few decades. Significant drought conditions were observed during years of late 1980s and the trend continued in the late 1990s. The magnitude of drought related losses and impacts in the agricultural sector and water resources indicates a continuing vulnerability of the country to drought. The annual mean temperatures remained above average in the last five years. A significant drought was observed during the years of 1999 and 2000, which were associated with a lack of precipitation during the winter and spring, which normally are the wettest seasons. Risk of drought is still a major concern in parts of Turkey where the rainfall is highly variable and low. The combination of rainfall deficiency with other climatic factors, and in particular high temperature, creates serious risk of drought in the central and south-eastern parts of the country where agriculture is the main economic sector.

Specially, the Turkish State Meteorological Service (TSMS) as the specialized institution is responsible for forecasting, observation, data collection and dissemination of meteorological information.

There has been considerable effort made by TSMS in recent years to improve its technological capabilities and human resources for a better and more advanced forecasting of droughts and other climatic events. In that sense, it has become a priority of TSMS to set up a network of radar and automated weather stations that will lead to early warning of climate-related natural hazards at regional and subregional level.

Studies carried out at TSMS with regard to early warning of drought are limited to using various drought indices and hydro-meteorological analysis. However, more recently there has been a new attempt to use additional techniques for early warning of drought, namely the Standard Precipitation Index (SPI) model which is a computerized version. The studies on drought and desertification carried out at TSMS have two main components:

1. Development of SPI Model Software for drought analysis and estimating critical rainfall values for drought forecasting, and

2. Implement the SPI model to determine and monitor dry and wet spells in Turkey in spatial and temporal terms and lead to some conclusions about desertification vulnerability.

The first component of the work has been completed and the model has been under test studies for varying geographical regions. By means of this model, it is possible to take measures against natural hazards based on climatic circumstances beforehand. Evaluation, determination and monitoring of wet and dry periods at time scales of 3, 6, 12, and 24 months, in accordance with location and time, could be done by using the SPI model in Turkey.

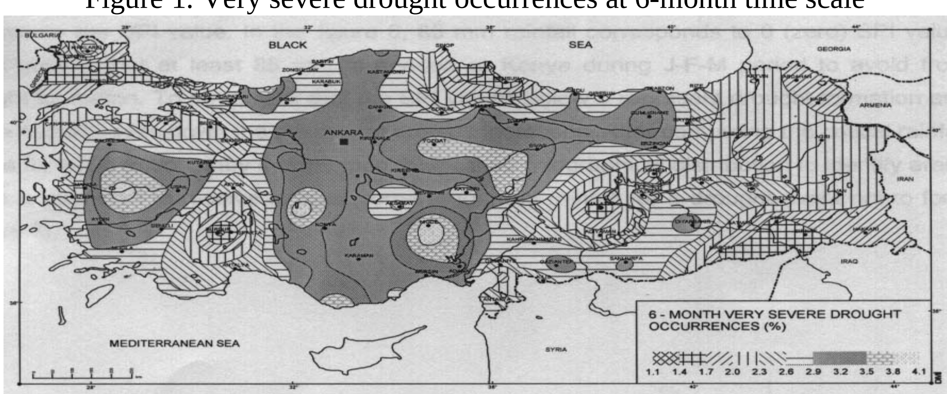
It is our view that development of a drought monitoring system based largely on meteorological and climatic information can be a great help for early assessment of drought impacts in Turkey. In this sense, the SPI can be valuable to monitor climatic conditions particularly in drought-prone areas of the country. By the time all of the intended studies mentioned above are completed, TSMS's capability in early warning of droughts will improve considerably.

Drought occurrences in Turkey have been identified based on the frequency of the events for each drought category at different timescales. In other words, drought events have been categorized based on their frequency for varying drought categories at 3, 6, 12 and 24-month timescales and then were analysed on a regional basis. The aim here was to identify areas vulnerable to drought at comparable timescales based on their occurrence frequencies. As a sample, a table describing the above analysis is given below for Konya station located in the central part of the country where a semi-arid climate predominates (table 1). Then the frequencies were mapped to analyse their spatial distribution (figure 1).

Table 1. Drought occurrence in Konya station

SPI	Drought category	Time (%) 3-month	Time (%) 6-month	Time (%) 12-month
0 and -0.99	Mild drought	31.7	30.5	28.1
-1.00 and-1.49	Moderate drought	8.6	9.2	9.2
-1.50 and-1.99	Severe drought	4.1	3.6	6.2
<-2.0	Very severe drought	3.0	3.4	2.3

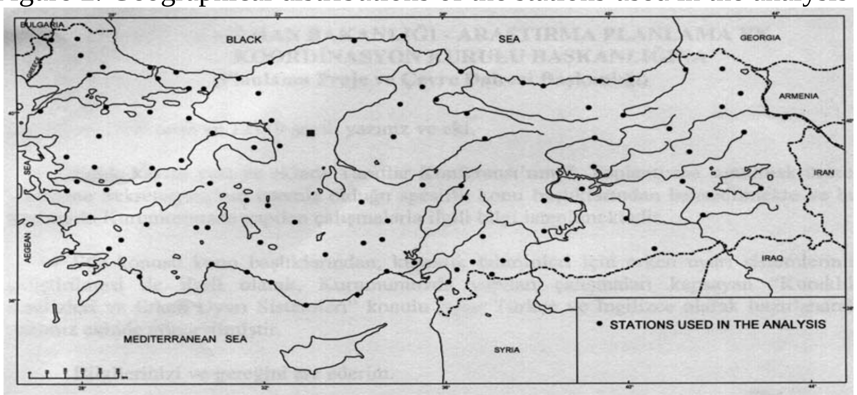
Figure 1. Very severe drought occurrences at 6-month time scale[1]



[1] The names of countries/territories, geographic topological names as well as the borderlines presented in this map do not reflect the official standpoint neither of the United Nations nor of the UNCCD.

The TSMS assesses an analysis of the drought variations in Turkey using drought frequency information at varying timescales (i.e. 3, 6 and 12-month) and drought severity categories and threshold rainfall values below which the drought is expected at different drought categories. The drought analysis has been made at a total of 101 stations distributed across the country and covered 1951-2004 periods (figure 2).

Figure 2. Geographical distributions of the stations used in the analysis[2]



The TSMS assessed overall meteorological drought vulnerability in Turkey by reconstructing historical occurrences of drought at varying timescales and drought categories.

Turkey's national action programme for the implementation of the Convention significantly addresses the role of meteorological forecasts, duties of the TSMS and the importance of early warning systems.

As was explained in the document of the Ad Hoc Panel on Early Warning Systems of the UNCCD, inadequate infrastructure, high costs of modern equipment, political restrictions and national security, and lack of data exchange are the major constraints to promoting and strengthening the early warning systems.

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[2] Ibid.